

Econ 219B
Psychology and Economics: Applications
(Lecture 2)

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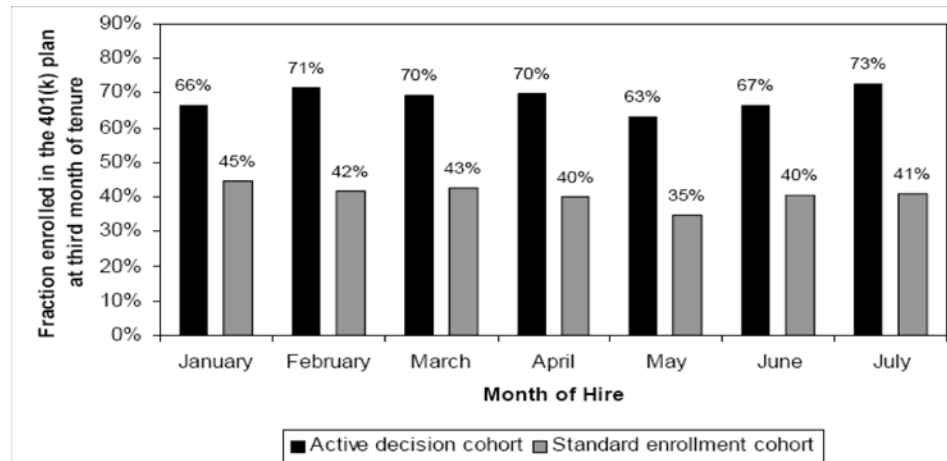
Outline

1. More on Default Effects in Savings
2. Comparison to Effect of Financial Education
3. Default Effects in Other Decisions
4. Default Effects and Present Bias
5. Default Effects: Alternative Explanations
6. Present Bias and Consumption
7. Investment Goods: Homework
8. Investment Goods: Exercise
9. Investment Goods: Work Effort

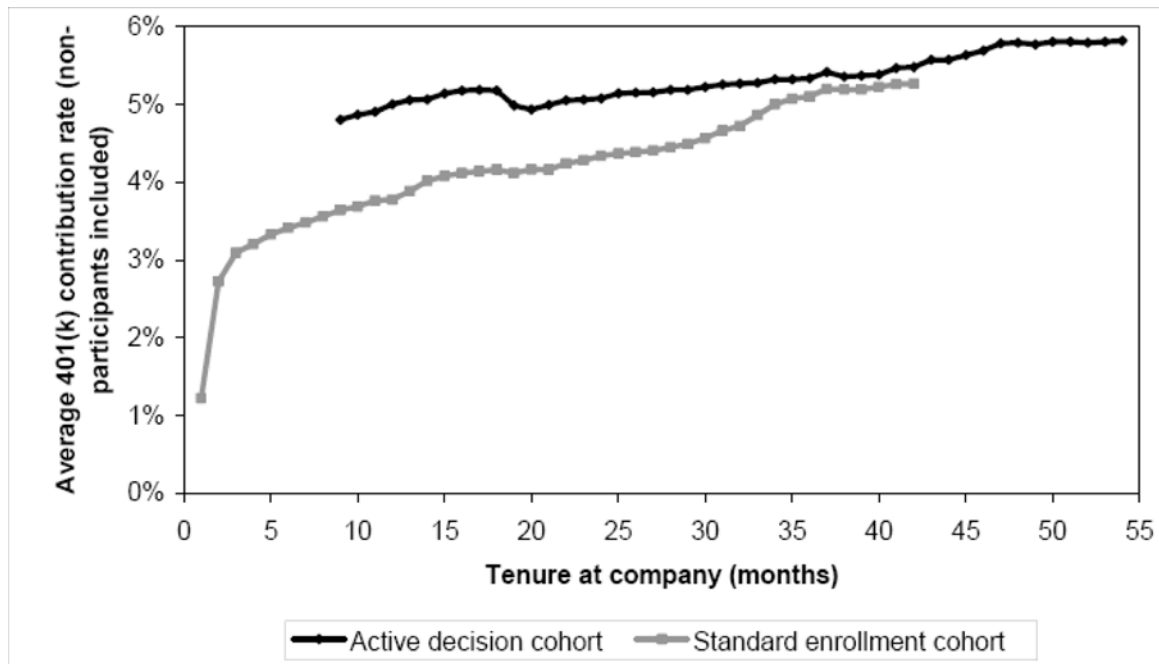
1 More on Default Effects

- ACTIVE Cohort, hired 1/1/97-7/31/97
 - 30 days to return 401(k) form with legal packet
 - Next enrollment period: January 1998
 - Paper-and-pencil form
- OLD2 Cohort, hired 1/1/98-7/31/98
 - Standard, no-saving-default (like OLD)
 - Can enroll any time
 - Telephone-based enrollment, 24/7

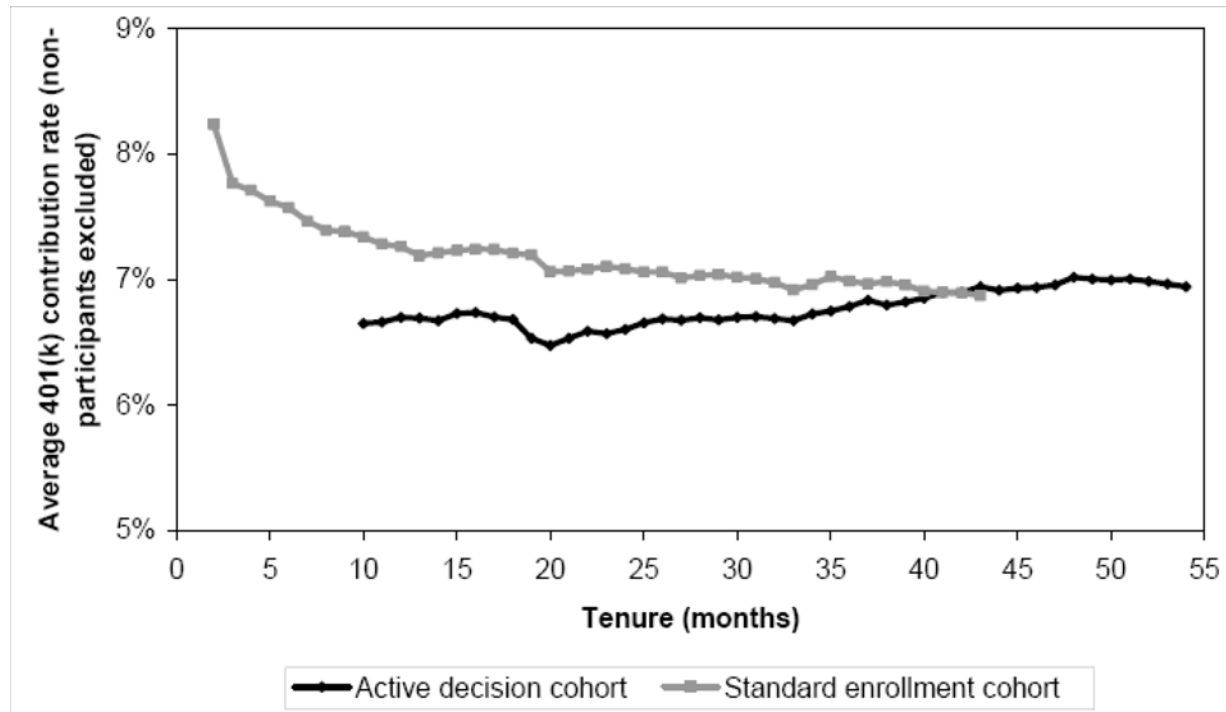
- Step 2. Compare plan choices (Figures 1 and 2)
 - *Participation* rates in 401(k) using cross-sectional data (Figure 1):
 - * ACTIVE: 69% – OLD2: 41% (at month 3)
 - * Compare to NEW (86%) and OLD (57%) in MS01 after >6 months
 - * Does not depend on month of hire (see below)



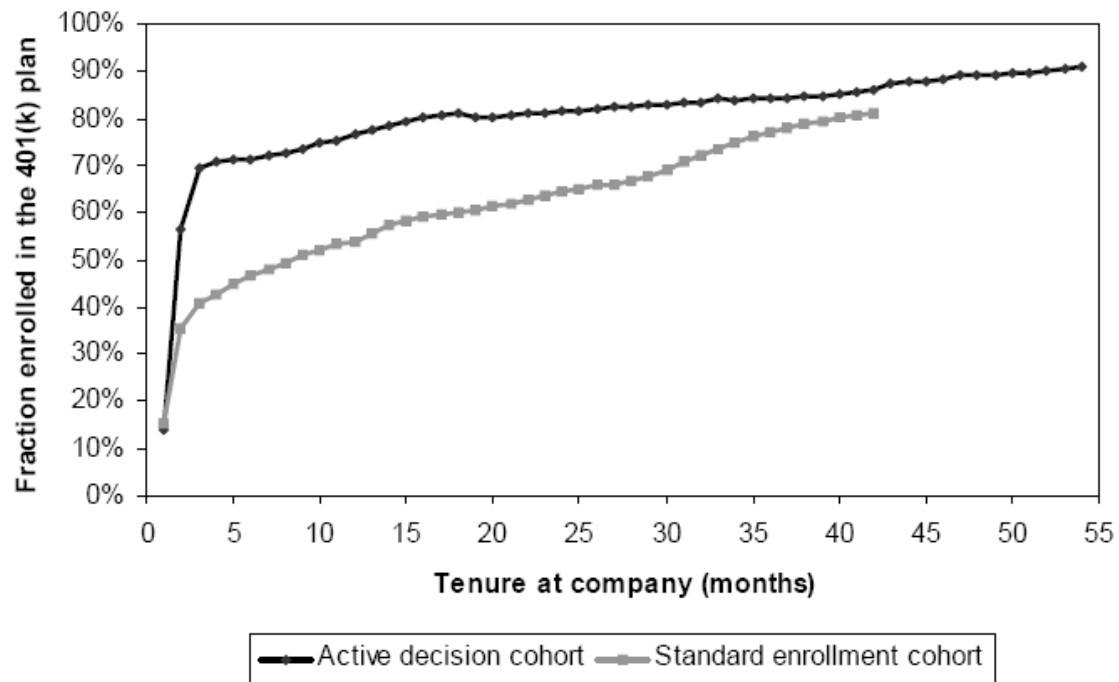
- – *Contribution* rates (including zeros) (Figure 3)
 - * ACTIVE: 4.8% – OLD2: 3.5% (at month 9, when longitudinal data becomes available)



- – *Contribution rates (excluding zeros)* (Figure 4)
 - * ACTIVE: 6.8% – OLD2: 7.5% (at month 9)
 - * Selection effect: Marginal individuals are lower savers



- – Differences between ACTIVE and OLD2 disappear by year 3 (Figure 2)
- Still: Important because no catch-up in levels, and because of frequent changes in employers



- Summary.
 - ACTIVE is close to NEW and differs from OLD and OLD2
 - * **Fact 3. Active Choice resembles Default Investment**
 - * Fact 3b. Month of Hire does not matter

 - **Fact 4. Effect of default mostly disappears after three years**
- Prevalence of OLD Default can (at least in part) explain under-saving for retirement

- Other evidence on default effects in choice of savings: Cronqvist and Thaler (2004, AER P&P)
 - Privatization of Social Security in Sweden in 2000
 - 456 funds, 1 default fund (chosen by government)
 - Year 2000:
 - * Choice of default is discouraged with massive marketing campaign.
 - * Among new participants, 43.3 percent chooses default
 - Year 2003:
 - * End of marketing campaign.
 - * Among new participants, 91.6 percent chooses default

- Side point for us (but key point in paper): Portfolio actively chosen in year 2000 does much worse than default

TABLE 1—COMPARISON OF THE DEFAULT FUND
AND THE MEAN ACTIVELY CHOSEN PORTFOLIO

Portfolio characteristic	Percentages ^a	
	Default	Mean actively chosen portfolio
Asset allocation		
Equities	82	96.2
Sweden	17	48.2
Americas	35	23.1
Europe	20	18.2
Asia	10	6.7
Fixed-income securities	10	3.8
Hedge funds	4	0
Private equity	4	0
Indexed	60	4.1
Fee	0.17	0.77
Beta	0.98	1.01
<i>Ex post</i> performance	−29.9	−39.6

2 Comparison to Effect of Financial Education

- Studies of the effect of financial education:
 - Cross-Sectional surveys (Bernheim and Garrett, 2003; Bayer, Bernheim, and Scholz, 1996)
 - * Sizeable impact
 - * BUT: Strong Biases (Reverse Causation + Omitted Vars)
 - Time-series Design (McCarthy and McWhirter 2000; Jacobius 2000)
 - * Sizeable impact
 - * BUT: Use self-reported desired saving
 - Need for plausible design

- Choi et al. (2005):
 - Financial education class (one hour) in Company D in 2000
 - Participation rate: 17 percent
 - People are asked: *“After attending today’s presentation, what, if any, action do you plan on taking toward your personal financial affairs?”*
 - Administrative data on Dec. 1999 (before) and June 2000 (after)
 - Examine effect:
 - * participants (self-selected) – 12% of them were not saving before
–> Demand for financial education comes from people who already save!
 - * non-participants
- Effect likely biased upwards

**TABLE 5. Financial Education and Actual vs. Planned Savings Changes
(Company C)**

Planned Action	Seminar Attendees		Non-Attendees
	Planned Change	Actual Change	Actual Change
Non-participants			
Enroll in 401(k) plan	100%	14%	7%
401(k) participants			
Increase contribution rate	28%	8%	5%
Change fund selection	47%	15%	10%
Change fund allocation	36%	10%	6%

The sample is active 401(k)-eligible employees at company locations that offered financial education seminars from January-June 2000. Actual changes in savings behavior are measured over the period from December 31, 1999 through June 30, 2000. Planned changes are those reported by seminar attendees in an evaluation of the financial education seminars at the conclusion of the seminar. The planned changes from surveys responses of attendees have been scaled to reflect the 401(k) participation rate of seminar attendees.

- Result: Very little impact on changes in savings, compared to non-attendees or to control time period

- Duflo and Saez (*QJE* 2003)
 - Target staff in prestigious university (Harvard? MIT?)
 - Randomized Experiment in a university:
 - * 1/3 of 330 Departments control group
 - * 2/3 of 330 Departments treatment group:
 - 1/2 not-enrolled staff: letter with \$20 reward for attending a fair
 - 1/2 not-enrolled staff: no reward

- Measure attendance to the fair and effect on retirement savings

TABLE I
DESCRIPTIVE STATISTICS, BY GROUPS

	Treated departments			Untreated departments (group $D = 0$)
	All (group $D = 1$)	Treated (group $D = 1,$ $L = 1$)	Untreated (group $D = 1,$ $L = 0$)	
	(1)	(2)	(3)	(4)
PANEL A: BACKGROUND CHARACTERISTICS				
TDA participation before the fair (Sept. 2000)	0.010 (.0015)	0.009 (.0021)	0.011 (.0022)	0.012 (.0024)
Observations	4168	2039	2129	2043
Sex (fraction male)	0.398 (.0076)	0.400 (.0109)	0.396 (.0107)	0.418 (.011)
Years of service	5.898 (.114)	5.864 (.161)	5.930 (.16)	6.008 (.157)
Annual salary	38,547 (304)	38,807 (438)	38,297 (422)	38,213 (416)
Age	38.3 (.17)	38.4 (.24)	38.2 (.24)	38.7 (.24)
Observations	4126	2020	2106	2018
PANEL B: FAIR ATTENDANCE (REGISTRATION DATA)				
Fair attendance rate among non-TDA enrollees	0.214 (.0064)	0.280 (.01)	0.151 (.0078)	0.049 (.0048)
Observations	4126	2020	2106	2018
Fair attendance rate for all staff employees	0.192 (.0132)			0.063 (.0103)
Observations	6687			3311
PANEL C: TDA PARTICIPATION (ADMINISTRATIVE DATA)				
TDA participation rate after 4.5 months	0.049 (.0035)	0.045 (.0049)	0.053 (.0051)	0.040 (.0045)
Observations	3726	1832	1894	1861
TDA participation rate after 11 months	0.088 (.005)	0.089 (.0071)	0.088 (.007)	0.075 (.0065)
Observations	3246	1608	1638	1633

- Summary of effects:
 - Large effect of subsidy on attendance (including peer effect)
 - Small effects of attendance on retirement savings

	Dependent variable		
	Fair attendance (1)	TDA enrollment after	
		4.5 months (2)	11 months (3)
PANEL A: Average effect of department treatment			
Treated	0.166	0.0093	0.0125
Department dummy <i>D</i>	(.013)	(.0043)	(.0065)
Observations	6144	5587	4879
PANEL B: Effect of letter and department treatment			
Letter dummy <i>L</i>	0.129	-0.0066	0.0005
	(.0226)	(.0061)	(.0102)
Treated	0.102	0.0125	0.0123
Department dummy <i>D</i>	(.0139)	(.0054)	(.0086)
Observations	6144	5587	4879

- Results:

- Approximately: Of the people induced to attend the fair, 10% sign up
- Compare to Default effects: Change allocations for 40%-50% of employees

- Summary:

- Just explaining retirement savings not very effective at getting people to save
- Effect of changing default much larger
- Interesting variation: Re-Do this study *but* give opportunity to sign up at fair

3 Default Effects in Other Decisions

- Additional evidence of default effects in other contexts:
 1. SMRT plan for savings (Thaler and Benartzi, *JPE* 2004)
 2. Health-club contracts (DellaVigna and Malmendier, *AER* 2006)
 3. Car insurance plan choice (Johnson et al, 1993)
 4. Car option purchases (Park, Yun, and MacInnis, 2000)
 5. Consent to e-mail marketing (Johnson, Bellman and Lohse, 2003)
 6. TV channel choice (Esteves-Sorenson, 2008)
 7. Organ donation (Johnson and Goldstein, 2003; Abadie and Gay, 2006)

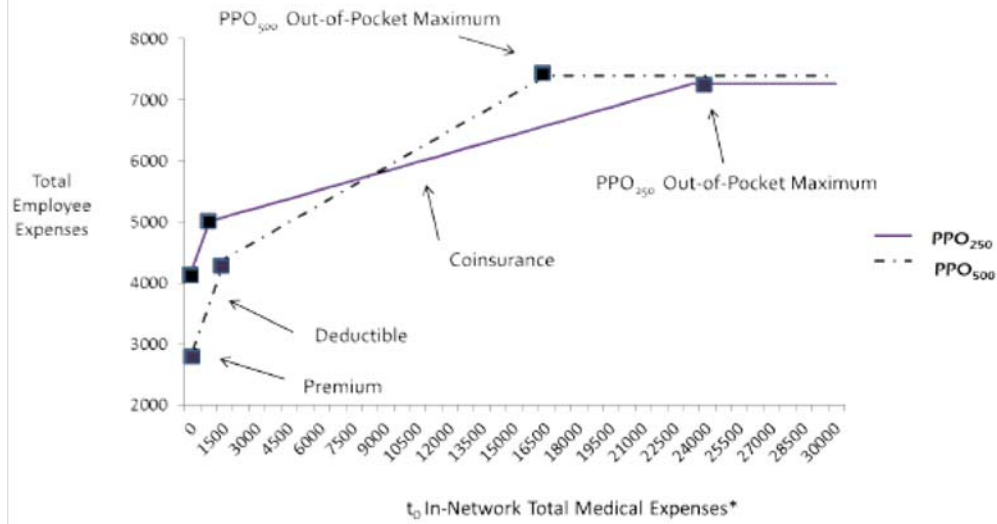
- Ben Handel, “Adverse Selection and Switching Costs in Health Insurance Markets: When Nudging Hurts”, 2011
 - Administrative data on health insurance choice within a company
 - Observe data in years t_{-1} , t_0 and t_1
 - Year t_0 : introduction of new plans, *active choice* required
 - Year t_1 : choice by default, but plan benefits changed substantially
 - Restrict choice to only PPO plans, *all offered by same insurer*
 - Only difference is financial details (premiums, co-pay, etc.)
 - Estimate individual risk characteristics using t_{-1} data, consider t_0 active choice, then inertial choice at t_1 *as option attractiveness varies*

- Options offered

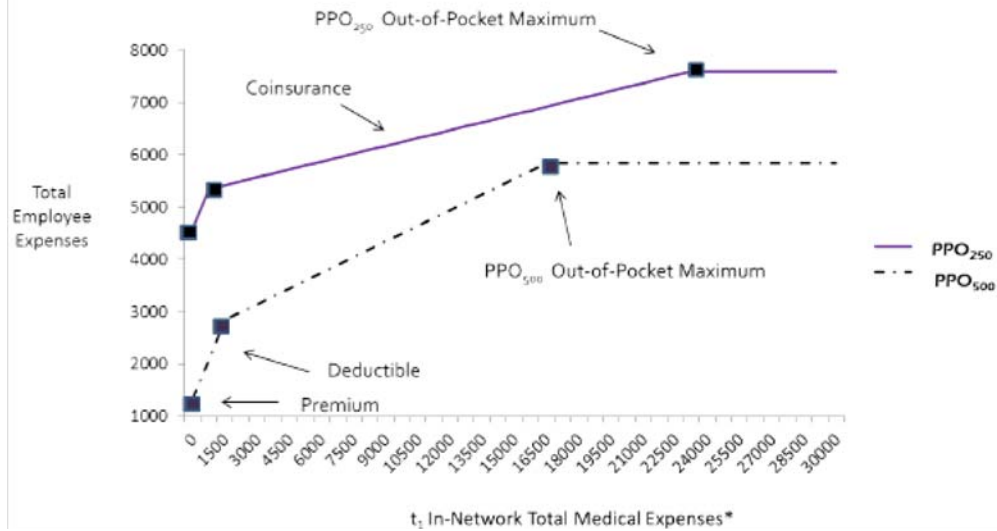
Choice Behavior	t_{-1}	t_0	t_1
<i>PPO</i> ₂₅₀	-	2,199 (25%)	1,937 (21%)
<i>PPO</i> ₅₀₀	-	998 (11%)	1,544 (18%)
<i>PPO</i> ₁₂₀₀	-	876 (10%)	824 (9%)
<i>HMO</i> ₁	2,094 (25%)	2,050 (23%)	2,031 (22%)
<i>HMO</i> ₂	701 (8%)	1,273 (14%)	1,181 (13%)
<i>PPO</i> ₋₁	3,264 (39%)	-	-
<i>HMO</i> ₃	668 (8%)	-	-
<i>HMO</i> ₄	493 (6%)	-	-
Waive	1,207 (14%)	1,447 (16%)	1,521 (17%)

- In particular, in year t_1 for a group *PPO*₂₅₀ is dominated – do employees still choose it? Yes,

PPO Health Insurance Plan Characteristics, t_0
Low Income Family



PPO Health Insurance Plan Characteristics, t_1
Low Income Family



- Do employees in the dominated plan still choose it? Yes, a majority still after two years

Dominated Plan Analysis

	t_1 Dominated Stay	t_1 Dominated Switch	t_2 Dominated Stay	t_2 Dominated Switch
N	498	61	378	126
Minimum Money Lost*	\$374	\$453	\$396	\$306
<i>PPO</i> ₅₀₀	-	44 (72%)	-	103 (81%)
<i>PPO</i> ₁₂₀₀	-	4 (7%)	-	6(5%)
Any <i>HMO</i>	-	13 (21%)	-	17 (14%)

- Descriptive evidence of strong inertia effects when comparing new enrollees

New Enrollee Analysis			
	New Enrollee t_{-1}	New Enrollee t_0	New Enrollee t_1
N, t_0	1056	1377	-
N, t_1	784	1267	1305
t_0 Choices			
PPO_{250}	259 (25%)	287 (21%)	-
PPO_{500}	205 (19%)	306 (23%)	-
PPO_{1200}	155 (15%)	236 (17%)	-
HMO_1	238 (23%)	278 (20%)	-
HMO_2	199 (18%)	270 (19%)	-
t_1 Choices			
PPO_{250}	182 (23%)	253 (20%)	142 (11%)
PPO_{500}	201 (26%)	324 (26%)	562 (43%)
PPO_{1200}	95 (12%)	194 (15%)	188 (14%)
HMO_1	171 (22%)	257 (20%)	262 (20%)
HMO_2	135 (17%)	239 (19%)	151 (12%)

- Model estimation
- Assumes individuals have a value for insurance based on previous risk
- Allows for asymmetric information
- Models the switching cost in reduced form as a cost k paid to switch – no cost in year t_0 when active choice

Empirical Model Results

Parameter	Primary	Base	MH Robust	γ Robust	ϵ Robust
Switching Cost - Single, η_0	1729 (28)	1779 (72)	1859 (107)	2430 (116)	1944 (150)
Switching Cost - Family, $\eta_0 + \eta_2$	2480 (26)	2354 (62)	2355 (113)	3006 (94)	2365 (34)

- Estimated cost of about \$2,000 is very unlikely to capture administrative costs
 - More likely to capture procrastination, or limited attention
 - Notice though: If no choice by deadline, can make no change until one year later
 - In this setting (see below), no procrastination expected even for naives
- However, consider alternative model:
 - Naive agent forgetful of deadline date
 - Then procrastinate until deadline, with probability of missing the deadline

- Paper also considers impact of *debiasing* which reduces switching costs
- All else equal, this is good for consumers
- BUT: inertia had side effect of limiting the adverse selection into contracts
→ Enables more pooling and therefore 'better' contracts
- Removing the inertia may make things worse in general equilibrium

4 Default effects and Present Bias

- How do we explain the default effects?
 - **Present-bias ((quasi-) hyperbolic discounting – (β, δ) preferences):**

$$U_t = u_t + \beta \sum_{s=1}^{\infty} \delta^s u_{t+s}$$

with $\beta \leq 1$. Discount function: $1, \beta\delta, \beta\delta^2, \dots$

- **Time inconsistency.** Discount factor for self t is
 - $\beta\delta$ between t and $t + 1 \implies$ short-run impatience;
 - δ between $t + 1$ and $t + 2 \implies$ long-run patience.
- **Naiveté about time inconsistency**
 - Agent believes future discount function is $1, \hat{\beta}\delta, \hat{\beta}\delta^2, \dots$, with $\hat{\beta} \geq \beta$.

Non-Automatic Enrollment (OLD Cohort in Madrian-Shea, 2001)

- Setup of O'Donoghue and Rabin (2001): One-time decision (investment)
 - immediate (deterministic) cost $k_N > 0$ with $k_N = k'_N + k''_N$:
 - * $k'_N > 0$ – effort of filling up forms
 - * $k''_N > 0$ – effort of finding out optimal plan
 - delayed (deterministic) benefit $b > 0$
 - $T = 1$ (can change investment every day)
- When does investment take place?

- **Exponential** employee ($\beta = \hat{\beta} = 1$):
- Compares investing now to never investing:

$$-k_N + \sum_{t=1}^{\infty} \delta^t b = -k_N + \frac{\delta b}{1 - \delta} \geq 0$$

- Invests if

$$k_N \leq \frac{\delta b}{1 - \delta}$$

- **Sophisticated** present-biased employee ($\beta = \hat{\beta} < 1$):

- Would like tomorrow's self to invest if:

$$\beta\delta \left[-k_N + \frac{\delta b}{1 - \delta} \right] \geq 0$$

- Would like to invest now if:

$$-k_N + \beta\delta \frac{b}{1 - \delta} \geq 0$$

- War of attrition between selves

- Multiple equilibria in the investing period: Invest every τ periods
- Example for $\tau = 3$. List strategies to Invest (I) and Not Invest (N) over the time periods 0, 1, 2, 3, etc.. Set of equilibria:
 - (I, N, N, I, N, N, I, N, N,...) \rightarrow Invest at $t = 0$
 - (N, N, I, N, N, I, N, N, I,...) \rightarrow Invest at $t = 2$
 - (N, I, N, N, I, N, N, I, N,...) \rightarrow Invest at $t = 1$
- There is no equilibria such that agent delays more than 2 periods

- *Bound on delay in investment.*

- Agent prefers investing now to waiting for T periods if

$$-k_N + \beta\delta \frac{b}{1-\delta} \geq \beta\delta^T \left[-k_N + \frac{\delta b}{1-\delta} \right]$$

- Simplify to

$$k_N \leq \beta\delta \frac{b(1-\delta^T)}{(1-\delta)(1-\beta\delta^T)} \approx \frac{\beta\delta b}{(1-\beta\delta^T)} T \approx \frac{\beta b}{1-\beta} T$$

[Taylor expansion of $1-\delta^T$ for δ going to 1: $0-T(\delta-1) = (1-\delta)T$]

- Maximum delay \bar{T} :

$$\bar{T} = k_N \frac{1-\beta}{\beta b}$$

- (Fully) **Naive** present-biased employee ($\beta < \hat{\beta} = 1$)
 - Compares investment today or at the next occasion (in T days).
 - Expects to invest next period if

$$-k_N + \frac{\delta b}{1 - \delta} \geq 0$$

- Invest today if

$$-k_N + \beta \delta \frac{b}{1 - \delta} \geq \beta \delta^T \left[-k_N + \frac{\delta b}{1 - \delta} \right]$$

- Procrastinate forever if

$$\frac{\beta b T}{1 - \beta} \lesssim k_N \leq \frac{\delta b}{1 - \delta}$$

- **Calibration**

- Cost k_N ?

- Time cost: 3 hours
- $k_N \approx 3 * \$12 = \36

- Benefit b ?

- Consume today ($t = T_0$) with tax rate τ_0 , or at retirement ($t = T_R$) with tax rate τ_R
- Compare utility at T_0 and at T_R :
 - * Spend S additional dollars at T_0 : $U'(C_0) * (1 - \tau_0)$
 - * Save, get firm match α , and spend S dollars at T_R : $\delta^{T_R - T_0} U'(C_R) * (1 + r)^{T_R - T_0} (1 - \tau_R) (1 + \alpha) S$
- Assumptions: $U'(C_0) = U'(C_R)$ and $\delta = 1 / (1 + r)$

- b is net utility gain from delayed consumption of S :

$$\begin{aligned} b &= \left[[\delta (1 + r)]^{T_R - T_0} (1 - \tau_R) (1 + \alpha) - (1 - \tau_0) \right] S = \\ &= [\tau_0 + \alpha - \tau_R (1 + \alpha)] S \end{aligned}$$

- Calibration to Madrian and Shea (2001): 50 percent match ($\alpha = .5$), taxes $\tau_0 = .3$ and $\tau_R = .2$, saving $S = \$5$ (6% out of daily $w = \$83$ (median individual income \approx \$30,000))
- $b \approx [.3 + .5 - .2 * (1.5)] S = .5S = \2.5
- Comparative statics:
 - * What happens if $\alpha = 0$?
 - * What happens if marginal utility at retirement is 10 percent higher than at present? (because of drop of consumption at retirement)
 - * Effect of higher earnings S ?

- What does model predict for different types of agents?
- **Exponential** agent invests if

$$k_N \leq \frac{\delta b}{1 - \delta}$$

- For $\delta^{365} = .97$, $\delta b / (1 - \delta) = 10,000 * b$
- For $\delta^{365} = .9$, $\delta b / (1 - \delta) = 3,464 * b$
- Invest immediately!
- Effect of k is dwarfed by effect of b

- **Sophisticated** maximum delay in days:

$$\bar{T} = k_N \frac{1 - \beta}{\beta b}$$

- For $\beta = 1$, $\bar{T} = 0$ days
- For $\beta = .9$, $\bar{T} = 36/(9 * 2.5) \approx 2$ days
- For $\beta = .8$, $\bar{T} = 36/(4 * 2.5) \approx 4$ days
- For $\beta = .5$, $\bar{T} = 36/2.5 \approx 14$ days
- Sophisticated waits at most a dozen of days
- Present Bias with sophistication induces only limited delay

- **(Fully) Naive** t.i. with $\beta = .8$ invests if

$$k_N \lesssim \frac{\beta T b}{(1 - \beta)}$$

- For $T = 1$ (I'll do it tomorrow), investment if $36 < 2.5 * \beta / (1 - \beta)$
 - * $\beta = .8$ (or $.5$) \rightarrow Procrastination since $36 > 2.5 * 4$ (or $36 > 2.5$)
- For $T = 7$ (I'll do it next week), investment if $36 < 5.6 * \beta / (1 - \beta)$
 - * $\beta = .8 \rightarrow$ Investment since $36 < 7 * 2.5 * 4$
 - * $\beta = .5 \rightarrow$ Procrastination since $36 > 7 * 2.5$
- Relatively small cost k can induce infinite delay (procrastination)
- Procrastination more likely if agent can change allocation every day

Automatic Enrollment (NEW Cohort in Madrian-Shea, 2001)

- Model:
 - $k'_A < 0$ – not-enrolling requires effort
 - $k''_A = 0?$ – do not look for optimal plan
 - $k_A = k'_A + k''_A < 0$
 - $T = 1$ (can enroll any day)
- Exp., Soph., and Naive invest immediately (as long as $b > 0$)
- No delay since investing has no immediate costs (and has delayed benefits)

- **Fact 1. 40% to 50% investors follow Default Plan**
- Exponentials and Sophisticates → Should invest under either default
- Naives → Invest under NEW, procrastinate under OLD

- Evidence of default effects consistent with naivete'
- (Although naivete' predicts procrastination forever – need to introduce stochastic costs)

- Can b be negative?
 - It can: liquidity-constrained agent not interested in saving
 - (consumption-savings decision not modeled here)
 - $b < 0$ for at least 14% of workers (NEW: 86% participate).
-
- Is there too much 401(k) investment with automatic enrollment?
 - With $T = 1$ and $k_A < 0$, naive guys may invest even if $b < 0$.

Active Choice (ACTIVE Cohort)

- Model:
 - $k'_C = 0$ – not-enrolling requires effort
 - $k''_C > 0?$ – harder to guess optimal plan than to set 0 investment
 - $k_C = k'_C + k''_C > 0$ (but smaller than before) or $k_C = 0$
 - $[T = 360$ under ACTIVE]

- Predictions:

- Exponentials and Sophisticates:

- * Predicted enrollment: $OLD2 \simeq OLD \simeq ACTIVE \simeq NEW$

- Naives:

- * $0 < k_C < k_A \rightarrow$ Predicted enrollment: $OLD2 = OLD \ll ACTIVE \leq NEW$

- * [Move from $T = 360$ (ACTIVE) to $T = 1$ (OLD2) \rightarrow Predicted enrollment: $OLD = OLD2 < ACTIVE$

- **Fact 3. Active Choice resembles Default Investment ($OLD \ll ACTIVE \simeq NEW$)**

- Findings consistent with naive'

- **Fact 4. Effect of default mostly disappears after three years**
- Problem for naivete' with model above: delay *forever*
- Introduce Stochastic cancellation costs $k \sim K \rightarrow$ Dynamic programming
- Solution for **exponential** agent. Threshold k^e :
 - enroll if $k \leq k^e$;
 - wait otherwise.
- For $k = k^e$ indifference between investing and not:

$$-k^e + \frac{\delta b}{1 - \delta} = \delta V^e(k^e)$$

where $V^e(k^e)$ is continuation payoff for exponential agent assuming that threshold rule k^e is used in the future.

- Threshold k^n for **naive** agent satisfies:

$$-k^n + \beta \frac{\delta b}{1 - \delta} = \beta \delta V^e(k^e)$$

- This implies $k^n = \beta k^e$
 - \rightarrow Investment probability of exponential agent: $\Pr(k \leq k^e)$
 - \rightarrow Investment probability of naive agent: $\Pr(k \leq \beta k^e)$
- This implies that distribution of k has important effect on delay \rightarrow Left tail is thin implies larger delays for naives

5 Default Effects: Alternative explanations

- A list of alternative explanations:

1. Rational stories
2. Bounded Rationality. Problem is too hard
3. Persuasion. Implicit suggestion of firm
4. Memory. Individuals forget that they should invest
5. Reference point and loss aversion relative to firm-chosen status-quo

- Some responses to the explanations above:

1. Rational stories

- (a) Time effect between 1998 and 1999 / Change is endogenous (political economy)
 - Replicates in Choi et al. (2004) for 4 other firms
- (b) Cost of choosing plan is comparatively high (HR staff unfriendly) → Switch investment elsewhere
- (c) Selection effect (People choose this firm because of default)
 - Why choose a firm with default at 3%?

2. Bounded Rationality: Problem is too hard

- In surveys employees say they would like to save more
- Replicate where can measure losses more directly (health club data)

3. Persuasion. Implicit suggestion of firm

- Why should individuals trust firms?
- **Fact 2.** Window cohort does not resemble New cohort

4. Memory. Individuals forget that they should invest

- If individuals are aware of this, they should absolutely invest before they forget!
- Need limited memory + naiveté

5. Reference point and loss aversion relative to firm-chosen status-quo

- First couple month people get used to current consumption level
- Under NonAut., employees unwilling to cut consumption
- BUT: Why wait for couple of months to chose?

6 Present-Bias and Consumption

- Consider an agent that at time 1 can choose:
 - A consumption activity A with immediate payoff b_1 and delayed payoff (next period) b_2
 - An outside option O with payoff 0 in both periods
- Activity can be:
 - Investment good (exercise, do homework, sign document): $b_1 < 0, b_2 > 0$
 - Leisure good (borrow and spend, smoke cigarette): $b_1 > 0, b_2 < 0$

- How is consumption decision impacted by present-bias and naiveté?
- **Desired consumption.** A time 0, agent wishes to consume A at $t = 1$ if

$$\beta\delta b_1 + \beta\delta^2 b_2 \geq 0 \text{ or } b_1 \geq -\delta b_2$$

- **Actual consumption.** A time 1, agent consumes A if

$$b_1 \geq -\beta\delta b_2$$

- *Self-control problem* (if $\beta < 1$):
 - Agent under-consumes investment goods ($b_2 > 0$)
 - Agent over-consumes leisure goods ($b_2 < 0$)

- **Forecasted consumption.** As of time 0, agent expects to consumer A if

$$b_1 \geq -\hat{\beta}\delta b_2.$$

- *Naiveté* (if $\beta < \hat{\beta}$):
 - Agent over-estimates consumption of investment goods ($b_2 > 0$)
 - Agent under-estimates consumption of leisure goods ($b_2 < 0$)
- Implications:
 - Sophisticated agent will look for commitment devices to align desired and actual consumption
 - Naive agent will mispredict future consumption

- Present evidence on these predictions for:

1. Investment Goods:

- Homework and Task Completion (Ariely and Wertenbroch, *PS* 2002)
- Exercise (DellaVigna and Malmendier, *QJE* 2006)

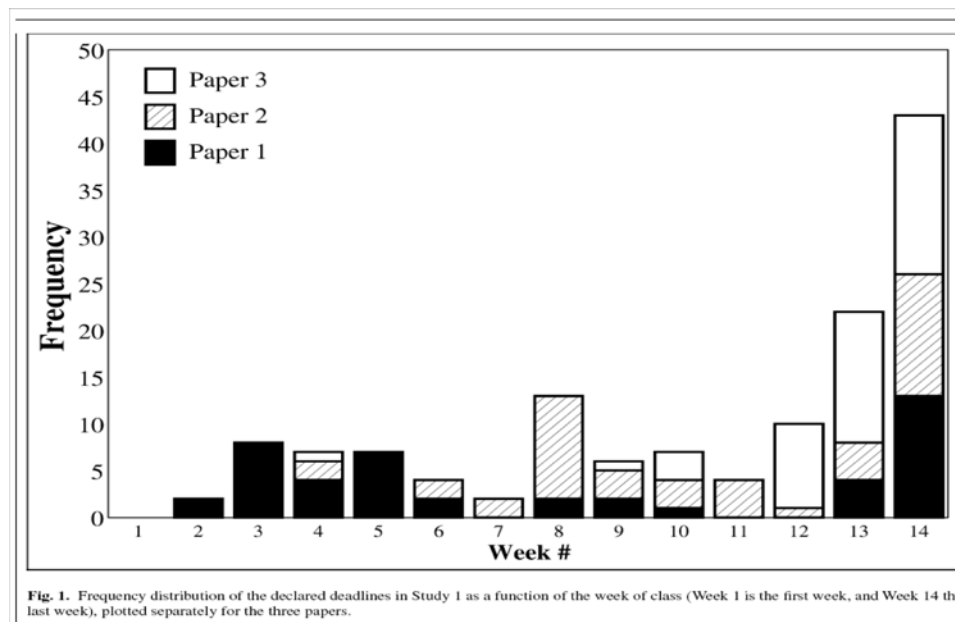
2. Leisure Goods:

- Credit Card Usage (Ausubel, 1999; Shui and Ausubel, 2005)
- Life-cycle Savings (Laibson, Repetto, and Tobacman, 2006; Ashraf, Karlan, and Yin, *QJE* 2006)

7 Investment Goods: Homework

- Wertenbroch-Ariely, "Procrastination, Deadlines, and Performance", *Psychological Science*, 2002.
- Experiment 1 in classroom:
 - sophisticated people: 51 executives at Sloan (MIT);
 - high incentives: no reimbursement of fees if fail class
 - submission of 3 papers, 1% grade penalty for late submission

- Two groups:
 - Group A: evenly-spaced deadlines
 - Group B: set-own deadlines: 68 percent set deadlines prior to last week
 - > Demand for commitment (Sophistication)



- Results on completion and grades:
 - No late submissions (!)
 - Papers: Grades in Group A (88.7) higher than grades in Group B (85.67)
 - Consistent with self-control problems
 - However, concerns:
 - * Two sessions not randomly assigned
 - * Sample size: $n = 2$ (correlated shocks in two sections)

- Experiment 2 deals with issues above. Proofreading exercise over 21 days, $N = 60$
 - Group A: evenly-spaced deadlines
 - Group B: no deadlines
 - Group C: self-imposed deadlines
- Predictions:
 - Standard Theory: $B = C > A$
 - Sophisticated Present-Biased (demand for commitment): $C > A > B$
 - Fully Naive Present-Biased: $A > B = C$
 - Partially Naive Present-Biased: $A > C > B$

- Results on Performance: $A > C > B$

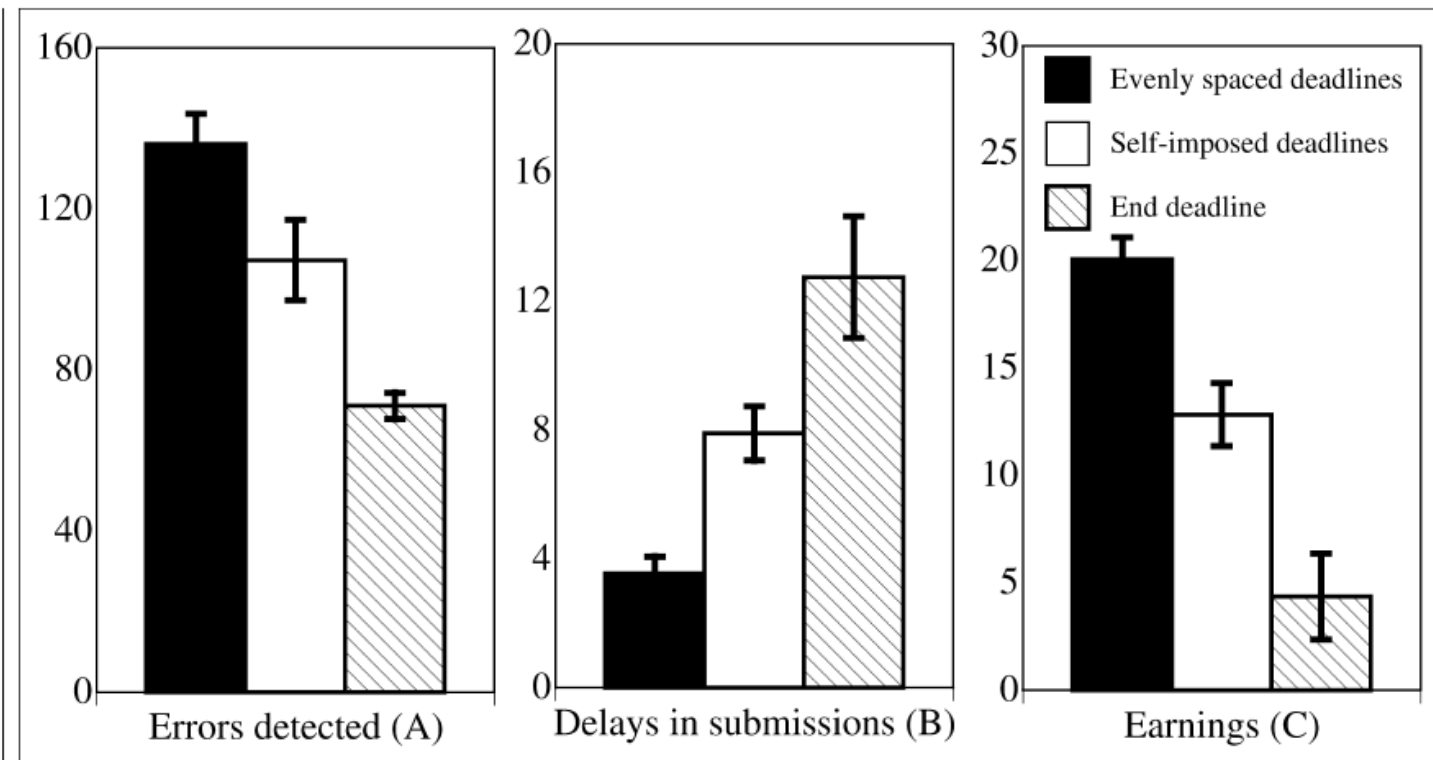


Fig. 2. Mean errors detected (a), delays in submissions (b), and earnings (c) in Study 2, compared across the three conditions (error bars are based on standard errors). Delays are measured in days, earnings in dollars.

- Main Results:
- Result 1. *Deadline setting helps performance*
 - Self-control Problem: $\beta < 1$
 - (Partial) Sophistication: $\hat{\beta} < 1$
- Result 2. *Deadline setting sub-optimal*
 - (Partial) Naiveté: $\beta < \hat{\beta}$
- Support for $(\beta, \hat{\beta}, \delta)$ model with partial naiveté

8 Investment Goods: Exercise

- DellaVigna, Malmendier, “Paying Not To Go To The Gym” *American Economic Review*, 2006
- Exercise as an investment good
- Present-Bias: Temptation not to exercise

Choice of flat-rate vs. per-visit contract

- *Contractual elements*: Per visit fee p , Lump-sum periodic fee L
- *Menu of contracts*
 - Flat-rate contract: $L > 0, p = 0$
 - Pay-per-visit contract: $L = 0, p > 0$
- *Health club attendance*
 - Immediate cost c_t
 - Delayed health benefit $h > 0$
 - Uncertainty: $c_t \sim G, c_t$ i.i.d. $\forall t$.

Attendance decision.

- Long-run plans at time 0:

$$\text{Attend at } t \iff \beta\delta^t(-p - c_t + \delta h) > 0 \iff c_t < \delta h - p.$$

- Actual attendance decision at $t \geq 1$:

$$\text{Attend at } t \iff -p - c_t + \beta\delta h > 0 \iff c_t < \beta\delta h - p. \text{ (Time Incons.)}$$

$$\text{Actual } P(\text{attend}) = G(\beta\delta h - p)$$

- Forecast at $t = 0$ of attendance at $t \geq 1$:

$$\text{Attend at } t \iff -p - c_t + \hat{\beta}\delta h > 0 \iff c_t < \hat{\beta}\delta h - p. \text{ (Naiveté)}$$

$$\text{Forecasted } P(\text{attend}) = G(\hat{\beta}\delta h - p)$$

Choice of contracts at enrollment

Proposition 1. If an agent chooses the flat-rate contract over the pay-per-visit contract, then

$$\begin{aligned} a(T) L &\leq pTG(\beta\delta h) \\ &\quad + (1 - \hat{\beta})\delta hT \left(G(\hat{\beta}\delta h) - G(\hat{\beta}\delta h - p) \right) \\ &\quad + pT \left(G(\hat{\beta}\delta h) - G(\beta\delta h) \right) \end{aligned}$$

Intuition:

1. *Exponentials* ($\beta = \hat{\beta} = 1$) pay at most p per expected visit.
2. *Hyperbolic* agents may pay more than p per visit.
 - (a) *Sophisticates* ($\beta = \hat{\beta} < 1$) pay for commitment device ($p = 0$). Align actual and desired attendance.
 - (b) *Naïves* ($\beta < \hat{\beta} = 1$) overestimate usage.

- Estimate average attendance and price per attendance in flat-rate contracts

TABLE 3—PRICE PER AVERAGE ATTENDANCE AT ENROLLMENT

Sample: No subsidy, all clubs			
	Average price per month (1)	Average attendance per month (2)	Average price per average attendance (3)
Users initially enrolled with a monthly contract			
Month 1	55.23 (0.80) <i>N</i> = 829	3.45 (0.13) <i>N</i> = 829	16.01 (0.66) <i>N</i> = 829
Month 2	80.65 (0.45) <i>N</i> = 758	5.46 (0.19) <i>N</i> = 758	14.76 (0.52) <i>N</i> = 758
Month 3	70.18 (1.05) <i>N</i> = 753	4.89 (0.18) <i>N</i> = 753	14.34 (0.58) <i>N</i> = 753
Month 4	81.79 (0.26) <i>N</i> = 728	4.57 (0.19) <i>N</i> = 728	17.89 (0.75) <i>N</i> = 728
Month 5	81.93 (0.25) <i>N</i> = 701	4.42 (0.19) <i>N</i> = 701	18.53 (0.80) <i>N</i> = 701
Month 6	81.94 (0.29) <i>N</i> = 607	4.32 (0.19) <i>N</i> = 607	18.95 (0.84) <i>N</i> = 607
Months 1 to 6	75.26 (0.27) <i>N</i> = 866	4.36 (0.14) <i>N</i> = 866	17.27 (0.54) <i>N</i> = 866
Users initially enrolled with an annual contract, who joined at least 14 months before the end of sample period			
Year 1	66.32 (0.37) <i>N</i> = 145	4.36 (0.36) <i>N</i> = 145	15.22 (1.25) <i>N</i> = 145

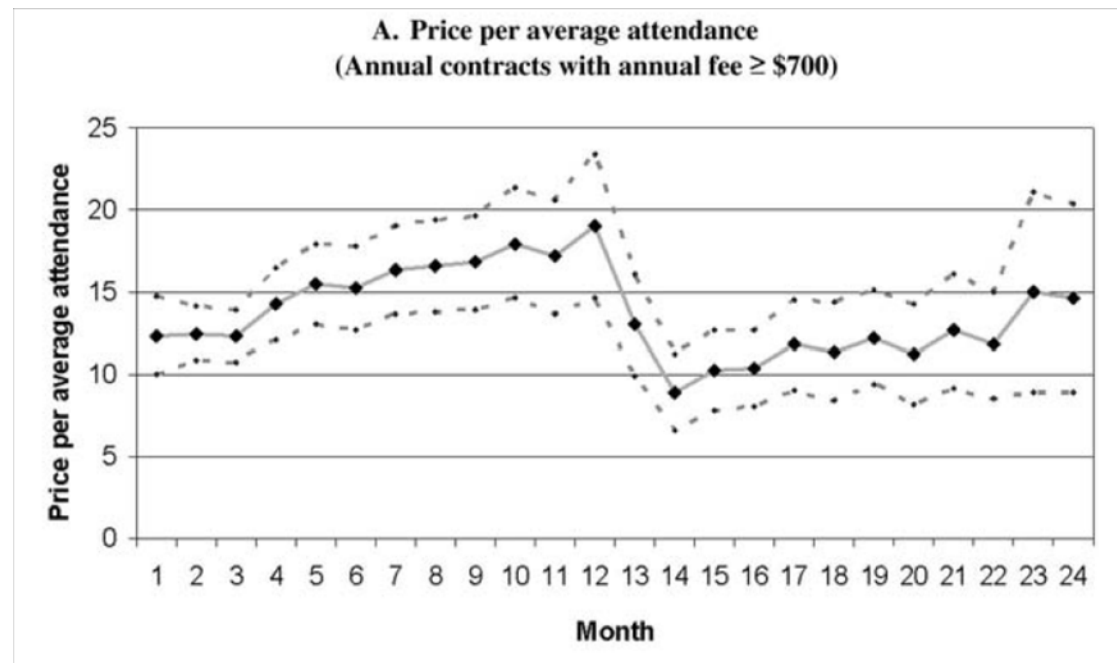
- Result is not due to small number of outliers
- 80 percent of people would be better off in pay-per-visit

TABLE 4—DISTRIBUTION OF ATTENDANCE AND PRICE PER ATTENDANCE AT ENROLLMENT

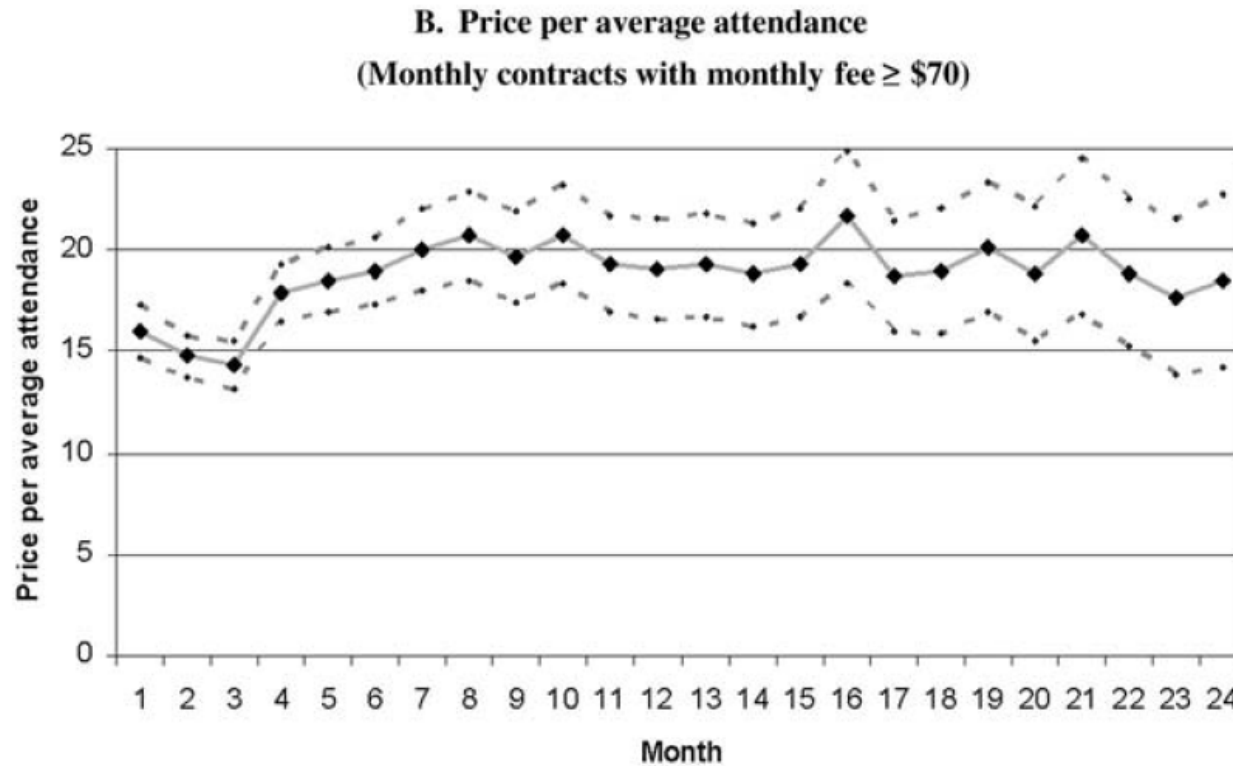
	Sample: No subsidy, all clubs			
	First contract monthly, months 1–6 (monthly fee \geq \$70)		First contract annual, year 1 (annual fee \geq \$700)	
	Average attendance per month (1)	Price per attendance (2)	Average attendance per month (3)	Price per attendance (4)
Distribution of measures				
10th percentile	0.24	7.73	0.20	5.98
20th percentile	0.80	10.18	0.80	8.81
25th percentile	1.19	11.48	1.08	11.27
Median	3.50	21.89	3.46	19.63
75th percentile	6.50	63.75	6.08	63.06
90th percentile	9.72	121.73	10.86	113.85
95th percentile	11.78	201.10	13.16	294.51
	<i>N</i> = 866	<i>N</i> = 866	<i>N</i> = 145	<i>N</i> = 145

Choice of contracts over time

- Choice at enrollment explained by sophistication or naiveté
- And over time? We expect some switching to payment per visit
- **Annual contract.** Switching after 12 months



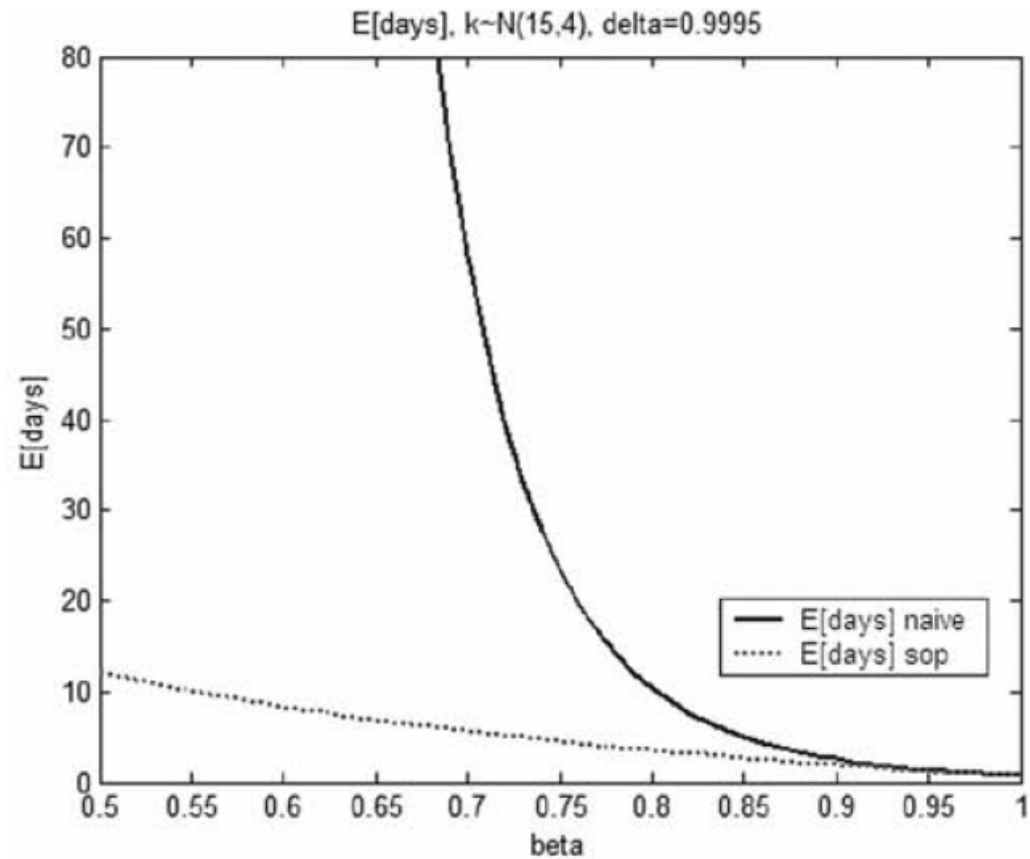
- **Monthly contract.** No evidence of selective switching



- Puzzle. Why the different behavior?

- Simple Explanation – Again the power of defaults
 - Switching out in monthly contract takes active effort
 - Switching out in annual contract is default
- Model this as for 401(k)s with cost k of effort and benefit b (lower fees)
- In DellaVigna and Malmendier (2006), model with stochastic cost $k \sim N(15, 4)$
- Assume $\delta = .9995$ and $b = \$1$ (low attendance – save \$1 per day)
- How many days on average would it take between last attendance and contract termination? Observed: 2.31 months

- Calibration for different β and different types



A. Simulated expected number of days before a monthly member switches to payment per visit
 Assumptions: cost $k \sim N(15,4)$, daily savings $s=1$, and daily discount factor $\delta = 0.9995$. The observed average delay is 2.31 months (70 days) (Finding 4)

- Overall:
 - Present-Biased preferences *with* naiveté organize all the facts
 - Can explain magnitudes, not just qualitative patterns
 - Acland and Levy (2009) elicit incentivized expectations of future gym attendance with ‘p-coupons’: significant over-estimation
- Alternative interpretations
 - **Overestimation of future efficiency.**
 - **Selection effect.** People that sign in gyms are already not the worst procrastinators
 - **Bounded rationality**
 - **Persuasion**
 - **Memory**

9 Investment Goods: Work Effort

- Kaur, Kremer, and Mullainathan, "Self-Control at Work"
- Setting: workers in India who are paid a piece rate w in a weekly paycheck
- Since effort at work is immediate and benefits delayed, effort at work is an investment good
- Assume β , but set $\delta = 1$
- Consider effort at work e , which costs $-c(e)$, with $c' > 0$, $c'' > 0$
- Assume for special case $c(e) = \gamma e^2/2$
- Two states:
 - high output y_H with probability $e \rightarrow$ pay w_H
 - low output y_L with probability $1 - e \rightarrow$ pay w_L

– Notice: this is only local approximation, for $e \in [0, 1]$

• Pay at $t = 2$

• If working at $t = 1$, maximize

$$\max_e \beta [ew_H + (1 - e)w_L] - c(e)$$

– f.o.c.

$$\beta [w_H - w_L] - c'(e^*) = 0$$

– Effort e^* increases in $w_H - w_L$ and in β

– Special case:

$$e^* = \frac{\beta [w_H - w_L]}{\gamma}$$

• If working at $t = 2$ (same period as payday), optimal effort is

$$[w_H - w_L] - c'(e^*) = 0$$

- **Prediction 1.** Effort is higher near payday for $\beta < 1$
- From $t = 0$ perspective, utility from working at $t = 1$ is

$$V_0 = e^* w_H + (1 - e^*) w_L - c(e^*)$$

- Effect of altering w_L on $t = 0$ welfare is

$$\begin{aligned} \frac{dV_0}{dw_L} &= (1 - e^*) + \frac{de^*}{dw_L} \left[[w_H - w_L] - c'(e^*) \right] = \\ &= (1 - e^*) + \frac{de^*}{dw_L} [(1 - \beta) [w_H - w_L]] \end{aligned}$$

- First term is direct effect on pay: lowering w_L lowers pay and thus welfare
- The second term is the effect on incentive, which is zero for $\beta = 1$, by the envelope theorem – but envelope theorem **does not apply** for $\beta < 1$. Indeed, second term is negative

– Special case:

$$\frac{dV_0}{dw_L} = 1 - \frac{\beta [w_H - w_L]}{\gamma} - \frac{\beta (1 - \beta) [w_H - w_L]}{\gamma}$$

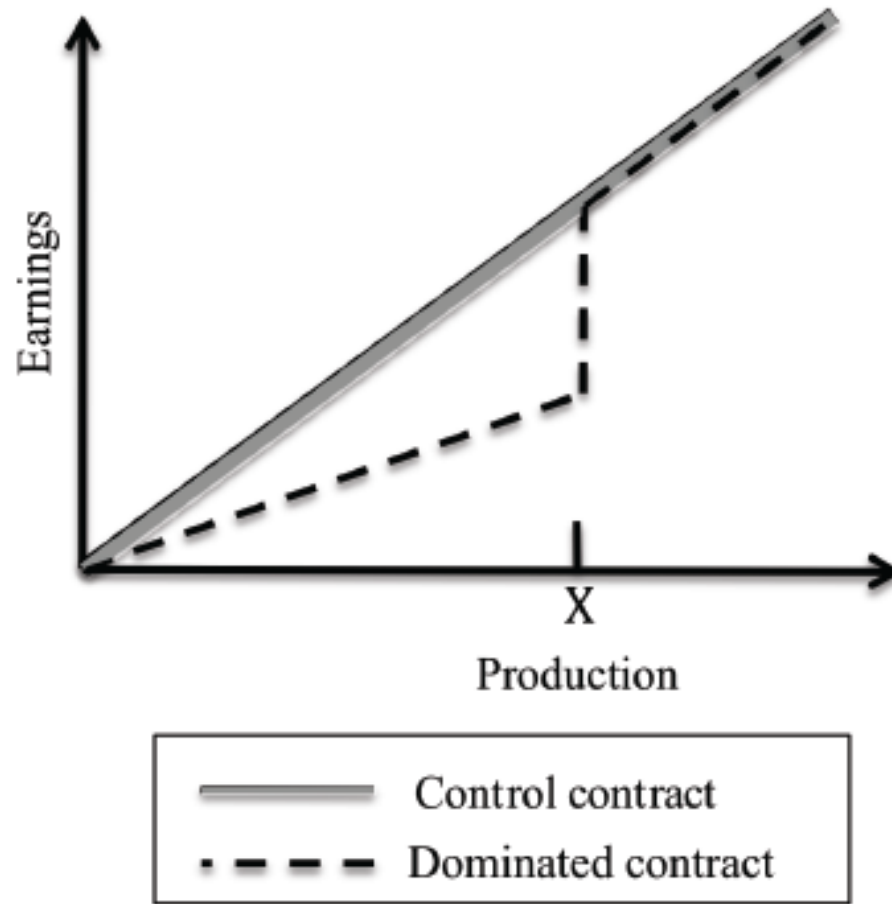
– Second term becomes large as β goes below 1 and is highest at $\beta = 1/2$

– If large enough, individual wants commitment device, prefers w_L low

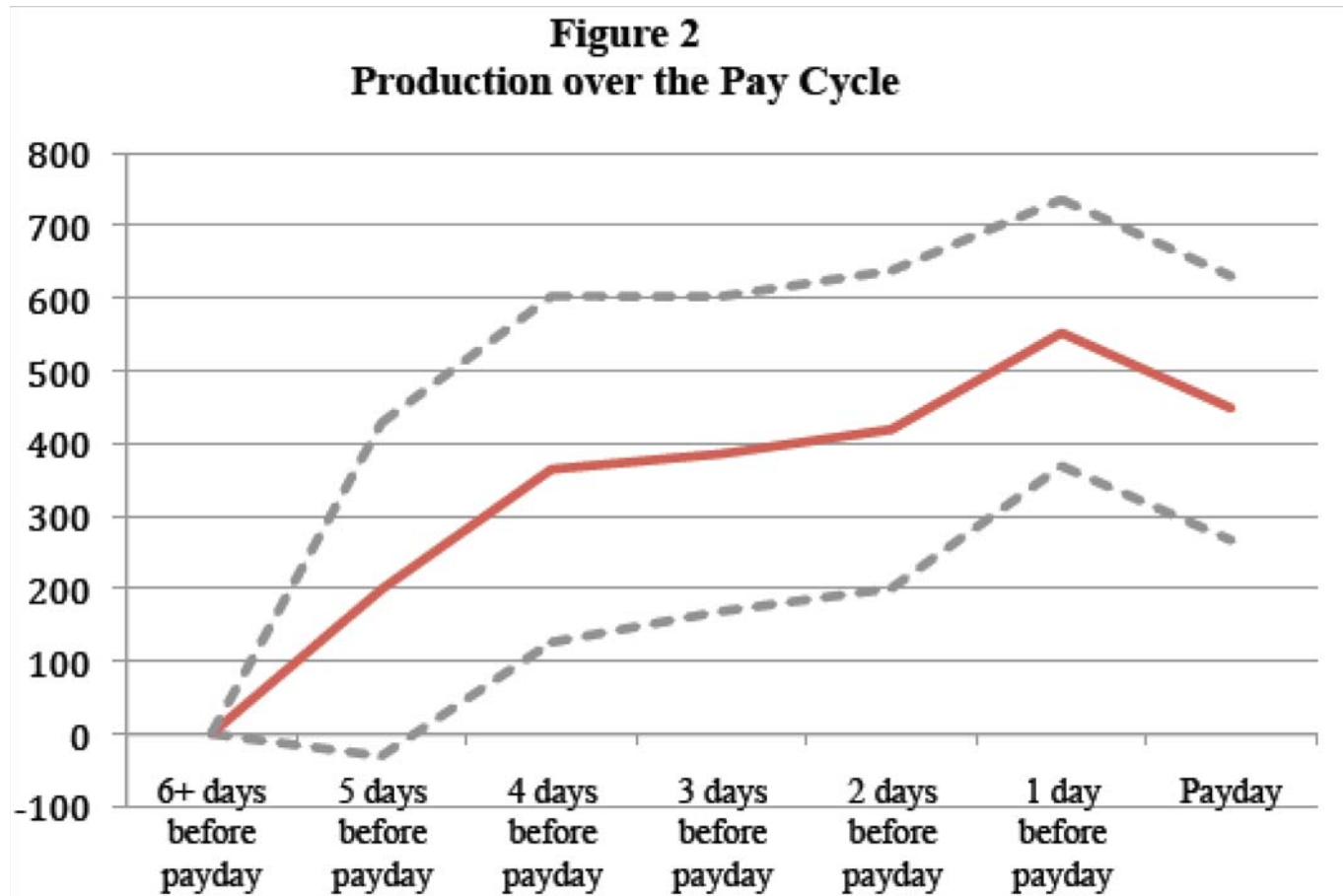
- **Proposition 2.** Individual with $\beta < 1$ may prefer commitment device (low w_L)
- **Proposition 3.** If there are both types with $\beta = 1$ and $\beta < 1$, demand for commitment should be associated with a payday cycle

- Field experiment in India
 - Randomization of pay date (Tu, Th, Sa) to test proposition 1 unconfounded with day-of-week effects
 - Randomization of availability of commitment device: get paid $w/2$ instead of w if miss production target
 - Randomization of whether choice is made evening before, or morning of

Figure 1
Incentive Contracts

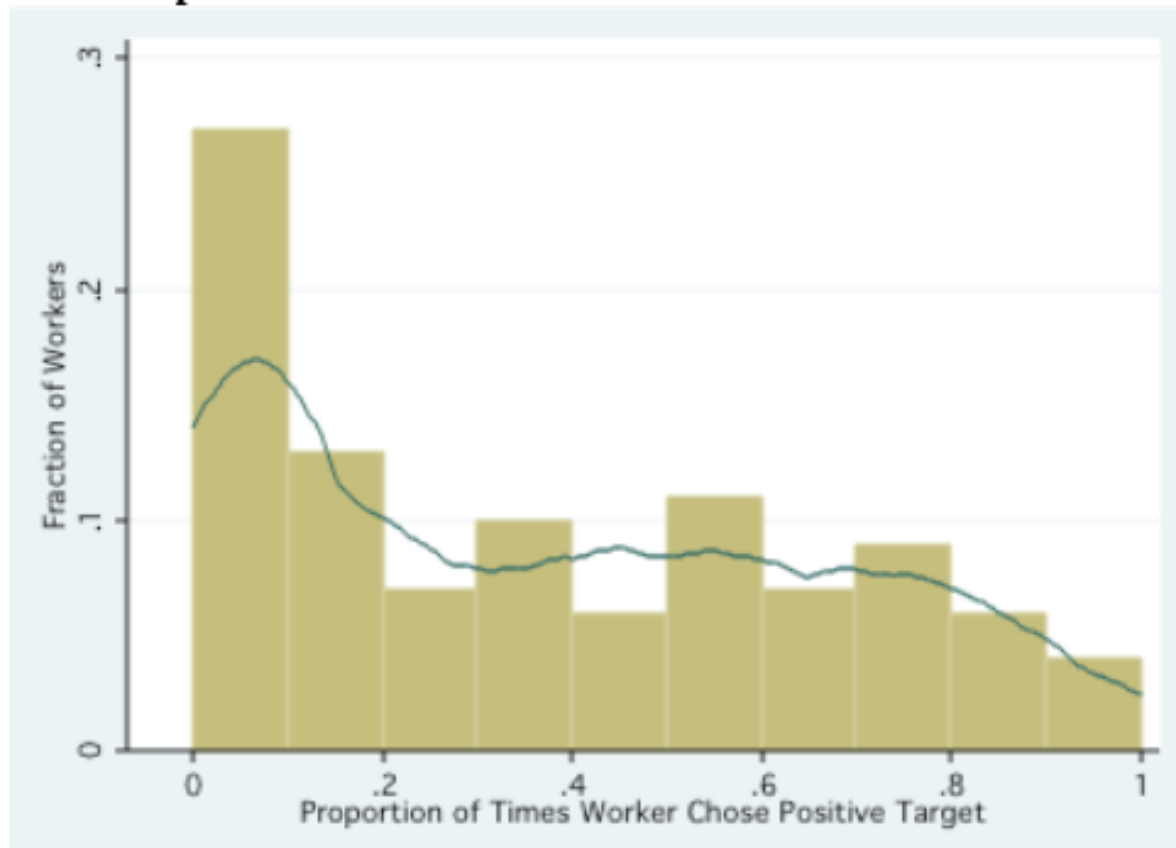


- **Prediction 1.** Evidence of pay cycle in effort



- **Prediction 2.** Quite significant take-up of commitment contract

Figure 3
Take-up of Dominated Contracts: Distribution of Worker Means



- **Prediction 3.** Correlation between payday effect and take-up of commitment, as well as with productivity effect

Table 5
Heterogeneity in Take-up of Dominated Contracts:
Correlation with Payday Impact

<i>Dependent variable</i>	<i>Target level chosen</i>	<i>Positive target indicator</i>
	(1)	(2)
High payday production impact	353 (129)***	0.138 (0.044)***
Seat fixed effects	Yes	Yes
Date fixed effects	Yes	Yes
Lag production controls	Yes	Yes
Observations	4098	4098
R2	0.22	0.20
Dependent variable mean	759	0.28

Table 6
Heterogeneity in Contract Treatment Effects: Correlation with Payday Impact

<i>Dependent variable</i>	<i>Production</i>	<i>Production</i>	<i>Production</i>	<i>Attendance</i>	<i>Attendance</i>	<i>Attendance</i>
	(1)	(2)	(3)	(4)	(5)	(6)
Assignment to choice	118 (60)*	-69 (74)	-146 (84)*	0.007 (0.009)	-0.016 (0.010)	-0.028 (0.011)**
Assignment to choice *		482	735		0.058	0.091
High payday production impact		(126)***	(144)***		(0.019)***	(0.022)***
Assignment to choice *			401			0.064
Payday			(179)**			(0.024)***
Assignment to choice * Payday *			-1314			-0.178
High payday production impact			(288)***			(0.041)***
Assignment to a target	153 (71)**	-35 (86)	-48 (96)	-0.003 (0.010)	-0.019 (0.012)*	-0.024 (0.013)*
Assignment to a target *		483	673		0.042	0.066
High payday production impact		(148)***	(168)***		(0.022)*	(0.025)***
Assignment to a target *			68			0.026
Payday			(219)			(0.029)
Assignment to target * Payday *			-972			-0.120
High payday production impact			(348)***			(0.049)***
Payday			-183 (153)			-0.009 (0.021)
High payday impact *			1178			0.164
Payday			(234)***			(0.032)***
Worker fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Seat fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Date fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Lag production controls	Yes	Yes	Yes	No	No	No
Observations	8240	8240	8240	8240	8240	8240
R2	0.60	0.59	0.59	0.11	0.11	0.11
Dependent variable mean	5355	5355	5355	0.875	0.875	0.875

- Evidence very consistent with model of self-control problems and (at least partial) sophistication
- Discount factor is not $\beta - \delta$, but smoother decay (true hyperbolic)
- Significant demand of commitment device – different than some of other settings, see later
- Correlation with underlying measure of self-control
- Great evidence in important setting

10 Next Week

- Present-Bias, Part 3:
 - Leisure Goods: Credit Card Borrowing (Ausubel, 1999)
 - Leisure Goods: Consumption (Laibson, Repetto, and Tobacman, 2006 and Ashraf, Karlan, and Yin)
 - Leisure Goods: Smoking (Gine Karlan, and Zinman, 2010)
 - Summary of the Present-Bias Applications
- Methodological Topic 2: Errors in Applying (β, δ) model